

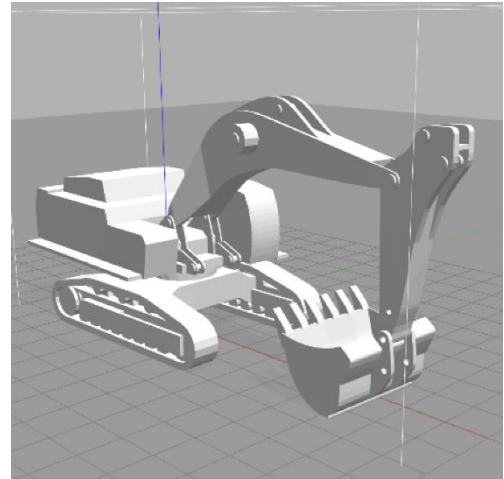
Masterarbeit

Reinforcement Learning-Based Control for Excavator Autonomous Operations

Hydraulic excavators are widely used in mining, construction, and various industries. Automating them can boost productivity and reduce the need for human operators by enabling efficient, safe, and stable multi-cycle excavation. This requires an autonomous system that senses its environment, plans tasks, monitors performance, and optimizes trajectories for reliable and safe operation.

Traditional nonlinear model-based control approaches rely heavily on precise mathematical models, which are difficult to obtain for hydraulic excavators. Recently, reinforcement learning (RL) controls have emerged as effective solutions to operations in complex environments.

This thesis aims to develop a RL-based controller to autonomously perform multi-cycle excavation tasks. Custom reward functions will enhance reliability and efficiency, while a simulation platform integrating hydraulic and mechanical systems will enable optimized training for a high level of autonomous control. This thesis work will be supported by a fundamental study from a previous MA at Mobima, including a simulation development tool and control programs.



The following steps are planned for the thesis:

- Research and survey on the topic.
 - RL-based control strategy design, aiming at reliable and efficient autonomous operations of excavators.
 - Simulation development tool modification and training of the proposed control.
 - Verification of the proposed control via simulation.
 - Documentation & presentation of results.
- If you are interested in this project, please feel free to send your application documents (i.e., **a brief cover letter, CV, and transcript**) to the email address below. Further discussions on the extension of the topic would be welcome.

Type of work:

- Main emphasis: simulation, RL control, reward function
- Areas: RL, robotics, control, automation

Start and duration:

From: January, 2025 or upon agreement
Duration: 6 months

Requirements:

- Interests in RL control and electro-hydraulic systems.
- A high degree of independence and motivation.
- Good academic performance and knowledge of German and English.
- Previous knowledge in RL control (e.g., TD3, PPO), reward function design, and simulation software for excavator operations (e.g., MuJoCo, Matlab Simulink, Simscape, or others).

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